

NEW TECHNOLOGIES AND LEC COMPETITION*

By

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Abstract

New telecommunications technologies are changing the costs of traditional services and creating a wide range of new services which could be offered by incumbent local exchange companies, unregulated subsidiaries of regional companies, or by new entrants. Incentives and funds for network modernization depend partly on regulatory policies towards rate design and collocation. Policy responses to the competitive environment include partial deregulation and increased pricing flexibility, with price caps protecting "captive" customers."

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1 Introduction

The pace and pattern of innovation have disrupted traditional regulatory approaches to telecommunications and the outcomes of the new policies are somewhat unclear. If we could peer ahead into the twenty-first century, we would find that many of today's predictions are not far off the mark. However, there would be enough surprises to make forecasters and policy-makers blush. Today's policies need to set a framework for regulatory decision-making that is conducive to firms making long-term investments, while also providing enough flexibility so that future developments can be incorporated into policies. The key issue is how to establish state and national regulatory policies which induce private decision-makers to capitalize on technological and commercial opportunities.

The assumption here is that public decision-makers establish key constraints on demanders and suppliers -- via entry restrictions, price and/or rate of return regulation, quality standards, and mandated cost allocations. Government-funded infrastructure investments would be consistent with highly competitive markets for enhanced services to the extent that access to network features could be priced at increment cost. However, given our present national deficit, this route is unavailable. Telecommunications infrastructure investments will be made by incumbent local exchange carriers (LECs) and by other technologically sophisticated firms: inter-exchange carriers--IXCs, cable TV companies, competitive access providers (CAPs), and firms capable of utilizing the radio spectrum. The latter include personal communications services (PCS) providers and cellular providers.

Whether present executives are capable of creating and evaluating the innovations needed for success is immaterial. If the fundamental technological forces dictate a unique industry configuration (eg., vertically integrated natural monopoly), we will discover that fact. A more likely scenario is that technological developments will be so pervasive that the best mix of technologies and suppliers will not be obvious to investors or customers. In such a setting, the industry structure will be strongly influenced by regulatory rules: the results of regulatory proceedings will be more important than outcomes in the marketplace. Ultimately, consumer preferences and corporate innovations will erode regulations that run counter to economic realities. However, unnecessary delays or uneconomic investments made because of artificial restrictions could cause inefficiencies which damage the economy's long run potential.¹

After a brief overview of technological threats to LECs in Section 2, we examine patterns of technological diffusion in Section 3. Historically, regulatory policies have affected the timing and deployment of enhanced services. An important issue for current policy makers is the impact of collocation on industry performance. Section 4 outlines how different regulatory policies affect innovation. Regulatory policies are under continuous scrutiny by affected parties--telecommunications customers, service providers, and equipment suppliers. Hopefully, our historical experience with cost allocation regulation, quality of service regulation, and price caps will have taught policy-makers and telco executives important lessons. Section 5 identifies rate design as the key determinant of telecommunications performance over time. However, if regulators try to use a single instrument (rate design) to achieve multiple goals (allocative efficiency, innovation, and fairness), they will become frustrated. This study concludes that the marketplace is a better mechanism than the hearing

¹For example, Rohlfs, Jackson and Kelly (1991) estimate a \$86 billion loss to the United States caused by the FCC's delay in licensing cellular telecommunications. This amount was about 2 percent of GNP in 1983--the beginning of cellular service.

room for discovering optimal industry configurations. No guru really knows whether it is efficient to have delivery of television services by today's LECs, personal communication networks by cable companies, or new electronic information services by IXCs and others.² The "discovery process" that matters is conducted by laboratory scientists and market researchers--not by regulatory lawyers.

2 Implications of New Technologies for the Planning Process

Specialization and division of labor generally dictate that economists focus on rate design issues while engineers address issues of network compatibility, technical protocols, and the evolution of technologies. However, telecommunications policy analysts must understand both the efficiency implications of new product pricing as well as the engineering implications of innovations. This point is illustrated by contrasting academic and managerial approaches to investment analysis.

2.1 Planning Horizons in Telecommunications

In academia, the long run and the short run are defined in terms of the variability of capital inputs. The venerable economic jargon conveniently distinguishes between feasible adjustments with and without modifications in the capital stock. What is omitted from the adjustment process is technological change. Such changes might be induced by particular time patterns of prices or they may stem from exogenous scientific developments. In either case, decision-makers in the real world do not make long-run decisions; they make decisions for a particular planning horizon (PH).

The PH will differ for different types of investments and for different expectations about technological changes. That point is crucial for regulators and telecommunications executives today: there is no such thing as a "long run equilibrium." The optimal industry configuration for the year 2000 is unknown at present. The preferred strategies for incumbents and entrants alike involve convincing regulators that a particular cost allocation scheme, entry restriction, or service quality standard is required for "the public interest." Such limitations on managerial flexibility may or may not be consistent with innovative efficiency. However, today's technological challenges are so pervasive that regulators should opt out of the role of managing competition in hundreds of emerging markets. They could turn, instead, to protecting consumers of core services who have no alternative sources of supply, thereby letting the rewards and losses associated with new investment decisions be borne by those who take risks over the planning horizon.

It is relatively easy to demonstrate that those risks are real for LECs. If the planning horizon is a decade, likely technological, commercial, and regulatory changes must be factored into the plan. Here, we focus on innovations having the potential to disrupt the market for local access and usage.

2.2 Technological Threats to Local Exchange Companies

Just as MCI served as a vehicle for cracking the long distance market, entrants in the local market have the potential to alter the structure of this industry. Firms such as Metropolitan Fiber Systems and Teleport can bypass the local loop in high density areas where rate averaging places the LEC at a competitive disadvantage. In addition, they provide secure capacity and have been quite

²Crandall (1992, p. 35) identifies these options as involving significant uncertainties. See Berg-Tschirhart (1988) for a survey of technological change under regulation (chapter 10).

responsive to user needs. Currently CAPs provide fiber-based transport between customer premises and the IXC point of presence (POP). Collocation offers the potential for by-passing local switching for other calls. A recent NRRI report by Bernt, Kruse, and Landsbergen (1992) argues that the "...formerly seamless [telecommunications] network has...been eroded at the edges" (p. iii) and that the local bottleneck (the class 5 office, which provides a unique number and switching, and the local loop) is facing attack. Mobility (via cellular and personal communications services) and increased bandwidth (via fiber optics) also meet customers' needs. FCC policy requires that cellular service providers be allowed interconnection to the public network. In addition, states such as New York and Illinois (*Local Competition and Interconnection, 1992*) promote collocation for CAPs. Readers are referred to the NRRI overview and to the scenarios outlined by those authors.³

It is increasingly clear that bypass within urban exchanges can threaten the financial viability of the LECs. Bruce et. al. (1986) identified eight technologies (or institutional arrangements) which had the potential to replace copper wire pairs. They are especially attractive to sophisticated, high volume users seeking high-speed, high-capacity capabilities:

- Institutional Cable--Cable B
- Digital Transmission Systems
- Cellular Radio Telephone
- FM Subsidiary Carrier Authorization
- Specialized Mobile Radio Service
- Local Area Networks (LANs) and Wide Area Networks (WANs)
- Shared Tenant Services
- Satellite Services: CPE and Teleports

Each has unique advantages (and disadvantages) which can only be touched upon here.

Many cable television operators agree to provide an institutional cable network (cable B) for serving business, government, and other institutional users. Such systems usually carry data transmissions over dedicated lines. As fiber optic transmission lines become the "backbone" of cable, the bypass possibilities increase. The fiber optic rings around major metropolitan areas represent serious competition for LEC delivery of business toll calls to or from IXCs.

Digital transmission systems and digital electronic message service systems utilize microwave technology (in the 10.6 to 18 GHz bands). They can provide origination and termination points for interLATA and interstate services. The radio spectrum has a number of additional possibilities.⁴ Suffice it to note that there are millions of subscribers to mobile cellular systems, and growth is rapid. Given the high fixed costs of cellular systems, population density has a dramatic effect on costs per call or per potential subscriber. FM Subsidiary Carrier Authorization (FM-SCA) has made the

³The issues are quite contentious. For example, Larson and Mudd (1992) question whether collocation will yield net consumer benefits.

⁴AT&T's recently-announced \$3.73 billion stake in McCaw Cellular communications represents a significant strategic alliance--allowing AT&T to link over two million subscribers in major markets. On November 9, 1992, MCI filed a plan asking the FCC to issue three nationwide licenses, enabling coalitions of firms to offer pocket-phone services on frequencies which are different from current cellular systems.

sidebands to the main channel frequency authorized by the FCC available for one-way data transmission (such as paging). In addition, Specialized Mobile Radio Service (SMRS) provides connections between commercial users in the 800 MHz band range. These uses of the spectrum do not replace paired copper wires, but represent techniques for bypassing the LEC.

The last three technologies offer further ways to bypass the local loop or replace intraexchange private lines. Local Area Networks (LANs) are generally based on coaxial cable, and provide high speed data transmission capabilities over small geographic areas--in buildings, a set of factories, or on a campus. Similarly, Wide Area Networks (WANs) are becoming major players in large metropolitan areas--with collocation facilitating local bypass. Other alternatives complement and sometimes substitute for WANs. Shared Tenant Services represent configurations of PBXs and links that aggregate the demands of disparate renters (or owners) of a building. A simple version of bypass occurs through Key Systems. In a small office complex, a person can access another user by touching a few keys. Similarly, access to the public network is available. Finally, earth satellite communications capabilities are accessible via rooftop dishes: customer premise earth stations provide the telecommunications link and teleports aggregate the local demands. Both LECs and IXC are bypassed in this setting.

What do these new technologies mean for the telecommunication industry? It is too early to tell. However, they illustrate the dramatic technical innovations and regulatory changes that have disrupted past arrangements. Innovations represent both threats to current stakeholders and opportunities for new entrants and incumbents alike.

3 Technology Diffusion in Telecommunications

New technologies alter economic opportunities, as when they enable Integrated Services Digital Networks (ISDN).⁵ Regulators and managers alike are trying to determine the least-cost mode of delivering services to homes, businesses, and governments. The optimal industry configuration seems to be a moving target. While few would suggest a return to the days of detailed administrative control of entry, prices, and returns, policy analysts are monitoring developments to ensure that components of our telecommunications infrastructure remain dynamic and accessible.

Incumbents and potential entrants are making investments utilizing the new technologies. In 1980, public network carriers made nearly all of U.S. network investment. By 1986, large users and private networks were making one-third of network investment. The modernization of telecommunications facilities and the introduction of new services are most likely to benefit relatively sophisticated customers, primarily large businesses. However, the subsequent diffusion of technologies and services can occur rapidly, as production volumes enable lower costs and as consumers become aware of the advantages available through new technologies. For example, the

⁵ Egan (1991) provides an in-depth analysis of broadband network economics. He examines the demand for integrated services digital networks (ISDN) and the institutional constraints erected by the regulators, Congress, and the courts. While some observe a polarization of positions between telephone and cable television, Egan (p. 158) argues that there is potential for cooperation for achieving a universal broadband network.

microcomputer became the personal computer as individuals found nonbusiness applications for advanced microprocessing capabilities.⁶

3.1 Timing and Deployment of Enhanced Services

The category "enhanced services" is somewhat elastic. As defined by the FCC, these are defined as services provided over common carrier transmission facilities which involve computer processing that alters or generates information (an opposed to just transporting it). The service reflects *enhanced transport* in which the information is changed, as through protocol conversion. This would include initial gateway services, allowing potentially incompatible computers to communicate with one another. End-user information services would include videotext (Compuserve), message services (voice storage and retrieval, E-mail) and on-line business information services (such as LEXIS--DIALOGUE).

In some cases, the telco could potentially provide the enhanced services. Computers allow providers to change the format, protocols, or content of information. Callers can interact with stored information. Such capabilities can be distinguished from custom calling features (call waiting or forwarding) and with services related to common carrier signaling service 7 (CCSS7) technology--which resides in the telco's central office and is programmed by the customer. Customer local area signalling service (CLASS) options include caller ID (incoming phone number display), call tracing, automatic re-dialing and selective call forwarding. However, at some point, the services made available via CLASS blend into the enhanced service category. Proposed broadband communication networks (with data rates allowing two-way video) would represent a significant investment--up to \$200 billion for the nation as a whole (Hammond, 1992).

Of course, there are different high speed and high volume transmission requirements associated with voice, data, and video. Storage and retrieval capabilities will also affect the financial viability of new telecommunications and information services. However, technological change can be expected to continue to relax the technical constraints. Adoption also depends on the nature of regulation and role of competition in the provision of new services.

Two fundamental regulatory issues have been identified by Lawton and Borrows (1990, p. 77):

- (1) Is access for advanced communications services desired through the segment of the public switched network?
- (2) Does the public switched network (or segment) have the facilities necessary to provide access to advanced communications services.

⁶The case of telecommunications is complicated by the infrastructure nature of the investment needed to provide advanced capabilities. Even this point ought not be viewed as too constricting, however, since digital systems are, by definition, capable of interconnection (at some cost). Interoperability may require compatibility standards, but the transmission of zeros and ones provides a basis for ubiquitous availability of cost-effective services. However, long depreciation schedules argue against modernization, since wireless could replace some applications. How long before broadband switches replace digital? And when do photonic switches replace them all?

"Yes" answers to both questions leads to the issue of who pays. Presumably beneficiaries should bear the costs. If the answers to both questions are "no", then demand and deployment can be monitored, but no regulatory initiatives are called for. For the other two cases, regulators must determine why deployment is too rapid or too slow. Ubiquitous provision of advanced capabilities only makes economic sense if business (and residential) valuations warrant the investments. Since it may be impossible to know these valuations in advance, regulatory problems include incentives for information acquisition and the determination of appropriate risk allocation.⁷

The cost and availability of enhanced services raises important issues. However, the key point is that first users will be paying premiums for associated technologies. At some point (possibly with a politically unacceptable delay) the technology, data base, or enhanced service offering will be available to most segments of the population. From the standpoint of efficiency, delayed introduction to the residential market is to be expected given the costs of reaching low density markets. However, the same types of penetration patterns that have resulted in virtually universal basic service will push enhanced services to residences. Of course, past systems of financial transfers through toll carriers are becoming unsustainable. Public policymakers could choose to accelerate the pace of telecommunications modernization, but they should consider possible benefits from alternative uses of direct telecommunications subsidies, such as additional funding for education or low income housing.

3.2 Distinctions Between Information Content and Conduit

The various FCC Computer Inquiries have attempted to draw lines or establish procedures which enabled non-integrated suppliers of information services to participate in this developing market. Traditionally, regulators have distinguished between information content (the creation of data bases) and conduit (provision of communications channels). Similarly, broadcasting license policy has traditionally encouraged ownership dispersion, both to limit market power and to promote multiple sources of news and information. The same goal is partly responsible for trying to separate those who provide communications channels from those who provide information services. Avoidance of market power is one issue--particularly from the standpoint of protocols or access points which favor the telephone carrier over other information provider. Another is the maintenance of multiple centers of initiative. Diversity is valued in-and-of itself, although lost economies of scope cannot be ignored.

3.3 Competition in the Local Exchange: Channels and Switching

How insulated are LEC finances from competitive pressures? Bypass technologies have been noted. However, that technological change has induced both decentralization and centralization in the industry. Telecommunications networks could be characterized as having two primary components: lines (or channels) and switching nodes. Innovations in switching technology have promoted decentralization: PBXs and Key Systems allow businesses to utilize fewer local lines. Large users are less dependent on the LEC for telecommunications services because of such capabilities (Lawton, 1988, p. 19). The demand for centrally provided utility switching services is reduced.

⁷Phillips (1989, 1991) has expressed concern that regulator-induced competition might lead to the loss of economies of scope in the production of related services.

On the other hand, developments in glass fiber run counter to the decentralizing tendency of remote digital switching. The scale economies associated with fiber optics support centralization of service provision. The data transmission carrying capacity of this technology based on glass threads far exceed the demands of most users. Fiber is becoming the backbone of many cable systems and serves the trunking needs of LECs. A fiber optic network appears to be a natural monopoly--particularly with regards to the last one-hundred feet. Path length becomes less important as network intelligence permits a range of route configurations.

Also, innovations in radio spectrum-using technologies could displace wire-based channels. These changes could promote centralization (utility provision) or decentralization (competition), depending on the capital intensity of the technologies. Microwave and satellite channels have tended to facilitate entry, but cellular radio is relatively capital intensive. Forecasts are not difficult to make--but they are generally difficult to justify.

4 Types of Regulation Affecting Innovation

Given the importance of continued innovation for industry performance, regulators must address a number of issues: cost allocation, quality of service, entry, and potential introduction of price caps. The resolution of each issue will affect incentives for innovation in the future. To these issues we turn.

4.1 Cost Allocation Regulation: from Separations and Settlements to Residual Pricing

Cost allocation is a key issue for regulated capital-intensive industries which serve different customer groups or produce services using shared inputs. Currently, exchange carrier cost categories are separated into intrastate or interstate jurisdictions. At the local level, some state commissions are trying to convince the FCC that its decisions to unbundle IXC access services may lead to a mismatch of revenues and costs between interstate and intrastate jurisdictions. Depending on how the FCC chooses to price interstate carrier access service elements, however, local callers may face price hikes to cover allocated costs. The arbitrary nature of non-traffic sensitive (NTS) cost allocation formulae and fully distributed cost procedures has been widely recognized, but now it is having clear and measurable effects for which regulators may be held accountable. Inappropriate cost allocation rules can yield inefficient price signals and unfairly burden particular customers.

The problem is particularly difficult for pricing new goods and services. Two intertemporal factors suggest that typical regulatory practice may be quite inappropriate: when there are customer "demonstration effects" on the demand side and "learning curve" effects on the firm's cost function.⁸ Both can be illustrated fairly easily. One way people become familiar with the capabilities of new technologies is by observing how their cohorts benefit from a new service. Some people will wait--observing how others utilize some new service. Such diffusion models characterize new service penetration patterns. In addition, some new services are valued on the basis of number in the network: having a fax machine is much more useful if many others have compatible equipment. Thus, over time, there is a demonstration effect and a network externality effect that both cause

⁸Faulhaber and Boyd, 1989. Mandated intertemporal or inter-product cost allocations can serve as a method for raising rival's costs. Hearing rooms can become clogged with expert witness swearing contests which pit entrants against incumbents. Consumers may not be well represented in such proceedings.

future demand to be a function of current consumption levels. A sufficiently high price during the early phase of a service life cycle can ensure that the new service is nonremunerative.

The production learning curve is another well documented phenomenon. Longer production runs in earlier periods promote learning which tends to lower costs in later periods. Such intertemporal production interdependencies imply that a simplistic intertemporal cost allocation scheme can doom a new service. Regulators could reduce the rate of new product development and introduction if the demand and cost interdependencies noted here are ignored in favor of, say allocating start-up costs to the initial period's revenue requirements. Period-by-period cost recovery can be very detrimental to both telcos and consumers.

Regulators can argue that they are trying to protect rate-payers when they require particular time patterns of cost recovery. Support can come from unregulated providers of substitute services who will want to keep introductory rates high for their regulated counterparts. They will charge predation, or that other regulated services are providing cross-subsidies for the service in question. Excluding regulated firms from such markets could deny consumers lower prices, and deny investors maximum opportunities to take advantage of shared inputs.⁹ Some analysts call for "residual pricing" of core services, using revenues from new services (with market-based prices) to cover a portion of shared costs. However, the share covered by new services would not be based on some arbitrary "fully allocated cost," but on what the market dictates. Thus, policy might encourage expansion into new services if economies of scope can be documented.

Regulators face extremely difficult policy choices in this area. Incentives for innovation are central to encouraging the introduction of new services; yet, the existence of economies of scope will only be discovered if regulators are willing to risk finding out that there are no such economies. The provision of information services raises just this type of trade-off. Prohibiting the regulated LEC from participating in new markets may simplify a regulator's life, but it does not necessarily make economic sense.

4.2 Quality of Service Regulation

Note that LEC quality of service issues still warrant attention. Service regulation has involved setting service standards and monitoring them to assure compliance. So long as price is above marginal cost, the firm does have an incentive to enhance quality which expands demand (Brennan, 1989). However, the quality improvements associated with network modernization are likely to be valued differently by different customer classes, and those valuations will change over time as residential subscribers become familiar with new services. Quality regulation is made more complicated by enhanced services.¹⁰

The balancing act will continue: "At least within the local exchange company, services which are valuable and can be provided by the LEC at costs considerably below providing them through

⁹For a critique of arguments regarding predation, see Berg and Weisman (1992). Sweeny (1982) shows the potential inefficiencies of fully distributed cost pricing.

¹⁰Evaluating plain old telephone service has tended to involve comparing performance to a myriad of pass-fail standards. (See Berg-Lynch, 1992.)

nonLEC alternatives will continue to exist. Services with those characteristics will include both the natural monopoly services based upon the location-specific advantages of the local loop and services for which the LEC has the benefit of economies associated with their provisioning of the local distribution system." (Lawton and Borrows, 1990, p. 111) Instead of regulators determining in advance which enhanced services have true cost complementarities with basic service, they may need to provide ways to let firms experiment with the introduction of new services--with price caps protecting core customers from cross-subsidizing the new services.

4.3 Price Cap and Incentive Regulation

In a sense, price cap regulation is not new. Joskow (1974) argued that price--rather than rate of return--regulation characterized the electric utility industry in the '50s and '60s. Rapid demand growth allowed the achievement of greater scale economies, and technological change shifted the cost structure downwards. Under these economic conditions, regulators focused on price rather than rate of return. However, the version of price caps introduced by the FCC provides an explicit break from past practice in telecommunications.

In March 1989, the FCC issued an order imposing its price cap scheme on the operations of AT&T¹¹ and issued a Further Notice of Proposed Rulemaking for application of the plan to the operations of the Bell operating companies. Their expectation is that price caps will provide more of an incentive for AT&T to lower operating costs in order to maximize their return on investment. States like Kansas and North Dakota have also moved in this direction. In the quest for potentially higher returns, companies would also pursue innovative technologies and introduce new services for customers.

This alternative approach to regulation establishes a base period price (which initially is derived from the firm's own costs). That price changes over time based on inflation (reflecting changes in the prices of inputs), which is partially offset by projected increases in productivity.¹² There can be many variations of price cap regulation depending on various factors: which input price index to use? how to forecast technological advances? how to alter the weights to be given various services? which services to include? However, the basic idea is to break the link between allowed revenues and the firm's own costs: cost savings beyond those allowed for by the productivity offset are retained by the firm. Investors may face greater risks, but the reward structure is now symmetrical.

¹¹See 4 F.C.C.R. 2873 (1989).

¹²Many economists support price caps as substitutes for rate base regulation. Braeutigam and Panzar (1989) conclude that ". . . rate-of-return regulation gives the firm incentives to misreport cost allocations, choose an inefficient technology (in some cases, undertake cost-reducing innovation in an inefficient way, underproduce in a noncore market, price below marginal cost in a competitive market which happens to be included in the set of core markets regulated by an aggregate rate-of-return constraint, and view diversification decisions inefficiently." (p. 390). Their litany of negatives is not a total condemnation of traditional regulation, but their points suggest that alternatives can offer advantages from the standpoint of production efficiency, new product introduction, and cost reduction over time. The administrative burdens of regulation will not disappear, but decision-makers ought to be able to focus directly on the policy issues of concern, rather than on detailed historical data which can clutter up regulatory proceedings--diverting attention from how utility activity affects industrial performance.

Braeutigam and Panzar (1989) show that, "... at least in principle, [price cap regulation] can induce the firm to minimize costs, produce efficiently in noncore markets, undertake cost-reducing innovation as an unregulated firm would, and diversify into a noncore market if and only if diversification is efficient. Incentives to misreport cost allocations and choose an inefficient technology simply disappear..." (p. 390). Such an endorsement must be tempered by a recognition of remaining implementation issues: What price levels are appropriate as a starting point? What is the role of multipart pricing in this process? Would the introduction of usage-sensitive prices be appropriate in some circumstances? What productivity index should be used to (partially) offset inflation adjustments? What items should be in the regulated bundle and what items should be essentially unregulated? What is the best regulatory lag before revisiting and evaluating the new regulatory mechanism?¹³

Of course, regulatory oversight does not disappear under such a regime. Brennan (1991) identifies two problems: quality deterioration and bundling which promotes price discrimination. Quality of service must still be monitored for capped services. The argument is similar to the case of poor maintenance for an apartment under rent control. The second problem, discrimination against competitors in access to its regulated services, is addressed by Open Network Architecture (ONA)--but bundling (or defining) services may allow the LEC to exploit market power associated with bottleneck facilities. Regulators need to address both issues.¹⁴

In addition, special attention may need to be given to politically powerful consumer groups, with the firm's pricing discretion constrained vis a vis customers with few options. As the cable TV industry learned the hard way, firms are still subject to potential re-regulation: regulators (and legislators) cannot pre-commit not to intervene again in the future. In fact, some sort of a re-evaluation and "true-up" after a given time period is often specified in negotiated price-cap agreement. Alternatively, a banded rate-of-return results in a share of the savings being passed on to core customers.

5 Rate Design and Financial Viability

Closely related to incentives for innovation are the rate design philosophies adopted by firms and regulators. The issues outlined here should not be taken as the only ones relevant to the financial viability of LECs or to incentives for modernization. However, they illustrate the types of issues facing state commissions. The four issues are pricing flexibility, telecommunications costs and

¹³ Cabral and Riordan (1991) also conclude that price cap regulation is superior to cost of service regulation from the standpoint of promoting innovation--so long as future price caps are not excessively low. Giving some pricing flexibility for noncore services also promotes innovation. Taylor, Zarkadas, and Zona (1991) analyzed the impacts of incentive regulation plans. They provide empirical support for these points: "Adoption of some form of incentive regulation, for a given year, is associated with an advance of approximately one year in the modernization of switching and transmission facilities, and approximately six months in the diffusion of ISDN and SS7 technology. Among the different types of incentive regulation, banded rate of return regulation and pricing flexibility are most strongly associated with increased modernization." (p. 1) Note that causation is complex; many state modernization plans were accelerated as the *quid pro quo* for the regulators' adopting incentive plans.

¹⁴See Graniere (1989) for an overview of ONA issues.

pricing structures, carrier of last resort obligations, and the interconnection of private and public networks.

5.1 Pricing Flexibility and Deaveraging

Pricing flexibility applies to a wide range of telephone company activity--in both regulated and unregulated services. Historically, average transport pricing (required by the MFJ) was sustainable due to the absence of alternatives. The presence of ALTs changes the equation. However, the degree of market discipline is difficult to estimate in the area of new services. Potential competitors will want to see telephone companies offering competitive services at high prices, while providing complementary services (such as access) at low prices. The issue of collocation illustrates this point. A recent Illinois Commerce Commission report stated the following:

The Commission will accomplish little for consumers if it takes action to further open entry to local exchange telecommunications and then "protects" consumers from lower prices by restricting the ability of the established carrier to respond. Then all that is created is a regulatory-sponsored cartel with inefficient providers. (ICC, p. 98)

Sorting through these issues will require the careful development of appropriate measures of the need for pricing flexibility.¹⁵

Regulators have been uncomfortable with providing utilities with discretion. How are firms to be held accountable for their actions? What cost allocations are implicit in the final mix of prices? Are projected or actual outputs the better weights to determine these implied allocations of shared costs? Are incremental costs as price floors adequate protection against undue discrimination and predatory pricing? It is clear that regulatory analysts and their utility counterparts are going to be spending much time resolving these policy issues.¹⁶

¹⁵Mudd and Starkey (1992) argue that collocation could become "...a mechanism for long-distance companies to vertically integrate their operations into local exchange markets less than a decade after the massive effort to separate the toll and local markets that culminated in the AT&T divestiture." (p. 511) Schwartz and Hoagg (1992) recount the NYPSA's policies towards NYNEX and New York Telephone. Structural safeguards were implemented so that the same organization would not provide both competitive and regulated monopoly services. The regional holding company has gained pricing flexibility for the former, while concerns over predation or cross-subsidization are reduced due to price caps for monopoly services. Of course, some economies of scope can be lost under "virtual divestiture." For an earlier discussion, see Kahn and Shew (1987) who review the principles of telecommunications pricing. Greenwald and Sharkey (1989) examine the economics of LEC deregulation, concluding that even if technologies indicate a natural monopoly, many regulatory reforms are desirable (including movement to price caps).

¹⁶One can argue that regulators have an incentive to adopt excessively conservative policies with regard to allowing a dominant incumbent firm greater flexibility. Regulators are not penalized (politically) for policies that deter innovation, since there is no clear "yardstick" for comparison. Conversely, regulators are penalized heavily (in the press) for allowing possible cross-subsidization or above normal financial returns. The resulting policies will tend to be skewed away from experimentation and innovation.

5.2 Telecommunications Costs and Pricing Structures

Telecommunications costing methodologies have implications for pricing structures. The movement towards cost-based prices in telecommunications introduces a number of regulatory dilemmas--long-run vs. short-run considerations, access (or option) costs vs. usage costs, network modernization for new services vs. costs associated with universal service, and bundling vs. unbundling of services. Regulators will not "solve" these dilemmas in the near future, but their resolution has consequences for alternative regulatory approaches to rate design.

We have already noted how time patterns of cost recovery affect the prices of new services. Modernization is an expensive process, with much of the demand appearing in the later part of the product life cycle. Thus, short run opportunity costs will tend to be extremely low, particularly given the importance of NTS costs. Firms must have forecasts of future demands, but these demands may be unrealized. Regulators will have to find ways to provide firms with pricing flexibility for new services, while avoiding cross-subsidization by demanders of basic service. Price caps for basic service were already noted as one way to provide incentives for cost minimization in the provision of basic service.

5.3 Carrier of Last Resort Obligations

The existence of non-compensatory pricing by a carrier of last resort raises additional issues in a partially competitive marketplace. The obligation to serve has been a traditional regulatory requirement, with the quid pro quo being entry restrictions which prevented what was perceived as "uneconomic by-pass" (or cream-skimming). Given the emergence of alternative access providers and private network operators, continued back-up (or default) responsibility raises tough issues for regulated local operating companies (Weisman, 1988). It is important that policy-makers develop pricing principles which are consistent with regulatory goals, lest customers with few options be left with significant financial burdens.

Creating ways to charge for "option demand" or backup capabilities could involve some bundling of services. Alternatively, self-selecting multipart tariffs could be utilized to identify groups with different valuations for the service. Such options conflict with cost-based pricing on the surface. But they may reflect the true opportunity costs of serving different types of customers. It is inefficient to offer free stand-by service for customers who have by-passed the LEC. It is also inequitable since it represents an insurance policy which is paid for other customers. Weisman (1990) argues that "...LECs are thus presented with a twofold opportunity--they are positioned to play a major role in the emerging market for faultless networks on the one hand, and to discourage economically inefficient bypass of their own network services on the other." (p. 341)

5.4 Interconnection of Private and Public Networks

The last issue, interconnection of private and public networks, raises concern over access to information services by the general telephone subscriber. This area raises a number of complex regulatory questions currently addressed under ONA and incentives for the introduction of new services. For example, the provision of gateway services will affect the diffusion of information services. What are the formats and protocols for an initial catalogue of services? How regulators respond will be important to the economic vitality of LECs.

Changes in switching technology and in transmission capabilities would seem to preclude a return to the style of regulation that seemed appropriate in the 1950s. No one seriously calls for such a dramatic policy reversal. Telecommunications has come of age, and consumers face options that would have been unavailable in a vertically integrated network. Despite the jurisdictional issues which arise in the context of ONA, new investments in intelligent digital switching and collocation will open up opportunities for potential suppliers to provide enhanced services. The question is whether current national and state regulations will promote network modernization, while avoiding inefficient duplication of capacity.

6 Concluding Observations

Eventually, the national telecommunications system seems likely to be based on fiber optics and digitized signals. We know that broadband systems can carry much more information than paired wires. The question is whether innovations increasing the bandwidth of current LEC delivery capabilities will prove to be cost-effective over the planning horizon for the "video dial tone." Pieces of the system may well be radio spectrum-based. Thus, it is not premature to speculate on whether telcos are likely to be in the cable television and/or database services businesses in the near future. Given their technological capabilities, we are likely to witness the transformation of telephone companies into broadband service companies. Even the twisted pair may turn out to provide a viable alternative to coaxial cable. Nevertheless, the outlines of common carrier/content split are likely to continue. Whatever the organizational form, every phone customer becomes a potential customer for additional services. Just as we do not now regulate what can be plugged into electrical outlets, we will probably not attempt to constrain the uses of our future information system.

The deregulation that has occurred may be partly a response to the conviction that the pattern of innovation is best determined by responses to economic rather than political forces. Efficiency, as reflected in commercial and technological opportunities, drives technology change. Of course, equity is also relevant. Given the social importance of developments in telecommunications, policy-makers must continue to monitor the situation so that captive or technologically unsophisticated customers are not unduly harmed by new developments. However, the invisible hand of the marketplace has many advantages relative to the gesturing hands of the hearing room.

Our state and national goals are diverse and sometimes in conflict with one another. Developing mechanisms for identifying the true opportunity costs of alternative policies is probably the most important task facing our political and social institutions today. In particular, the journalists and policy-makers who frame public policy questions have enormous power: perceived "problems" can be framed in such a way that a narrow set of "solutions" come to mind. When the issues are as complex as those in telecommunications, we need to examine a much wider set of policy options.

Ours is a nation of numerous constituencies. We have conflicting policies in many arenas either because we lack consensus on which objective is more important, or because the fundamental linkages between policies and objectives are not fully understood. The possibility of deploying new information technologies in telecommunications is a case in point. Plant modernization, the introduction of new communication services, and rate designs which reflect opportunity costs all affect economic performance. This overview of current issues underscores the need for re-thinking traditional rate of return regulation. New technologies and competitive entry require new approaches to telecommunications regulation. The task facing analysts is how to develop specific constraints and general oversight procedures which allow us to take advantage of the innovative capabilities of market processes, but which limit regulatory discretion so that potential benefits are not dissipated through corporate gaming and political opportunism.

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